A Ten-Month Comparison of All-Weather Pyrheliometers

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Thirty-three, commercially-available pyrheliometers were compared over more than nine months at the National Renewable Energy Laboratory (NREL) Solar Radiation Research Laboratory near Golden, Colorado. Included among the 33 instruments were four all-weather absolute cavity radiometers, which proved to be as stable as the open cavities that were used to periodically calibrate all pyrheliometers during the study. The average of the four all-weather cavities was chosen as the standard irradiance to which the other 29 pyrheliometers were compared. The two standard deviation precision of the cavity standard was ±1.2 W/m^2. In addition to the four all-weather cavities, there were seven sets of three pyrheliometers of the same make and model plus an additional eight prototypes in the study. These test instruments include those most widely used by the international community along with these new production models. Instruments were cleaned every workday. Analysis was performed by a non-participant in the experiment who had no knowledge of the identification of the instruments except for the cavity radiometers; the analyst also knew which three pyrheliometers formed a set. If the manufacturer provided temperature corrections, they were applied. The early analysis suggests four groupings of pyrheliometers: windowed cavity radiometers are the most accurate; followed by pryheliometers that have 95% uncertainties around ±5 W/m^2; followed by pyrheliometers with uncertainties between ±10 - 15 W/m^2; and then two prototypes that were clear outliers. The results will be illustrated; the identity of the instruments is pending completion of the analysis. The comparison was organized under the auspices of the Baseline Surface Radiation Network with instruments donated from many sources. NREL staff members were responsible for most of the observational activity.

Figure 1. All 33 instruments tracking the sun during the pyrheliometer comparison.